

Dear Sönke Zaehle,

thank you very much for your final comments and suggestions and the quick response. We addressed all points as summarized below (in grey: editor comments, in black: our reply/ suggested changes).

Abstract:

- not clear what the NEE sum is. Do you mean to say annual NEE?

Yes, we now replaced "NEE sum" by "annual NEE".

- sentence beginning with "Thus, the parameter estimates would". This sentence seems redundant to me with the previous sentence. In any case, I don't understand the use of would here, either the new parameters change the carbon balance, as was said before, or they do not, but given your results, there should be a clear answer.

We did not estimate the carbon balance (including fossil fuel combustion, carbon fluxes due to land use changes, etc.) but just NEE, therefore "would". We reformulated the sentence now: "Thus, the estimation of CLM parameters with local NEE observations can be of high relevance when determining regional carbon balances."

- sentence beginning with "The increase of sigma_sum_NEE" is hard to understand. Either revise to be clear ("substantially lower than for crops") or remove.

We replaced this sentence (Abstract, p.1, line 26ff) by:

"The NEE uncertainty for the forest PFT was considerably lower ($\sigma_{\sum NEE} \sim 4.0 - 13.5 \text{ gC m}^{-2} \text{ y}^{-1}$ with perturbed parameters, meteorological forcings and initial states). We conclude that LAI and NEE uncertainty with CLM is clearly underestimated if uncertain meteorological forcings and initial states are not taken into account."

introduction

P2 L2 NEE is the difference between soil AND PLANT respiration and photosynthetic CO2 uptake

Correct, the "and plant" somehow got lost on the way, we added it again.

P2 L17: use affect instead of determine (there are other factors as well)

Done.

P2 L21: Is Todd-Brown et al. 2013, which evaluates soil carbon stocks in ESMs really a good reference to suggest that the phenology of LSMs is flawed?

No, something was confused here. We now replaced the reference by "e.g. Richardson et al. 2012" and added "including CLM (Dahlin et al. 2015)".

P4 L23: remove duplicate ', 'b

Second “,” is removed now.

Additional changes:

In chapter 2.3.1. (p.8,l.20) we added:

“ $\text{DREAM}_{\text{I}_{\text{ZS}}}$ is based on the Bayes theorem (A1).”

To stress the high impact of Q_{10} on the uncertainty of carbon fluxes for forest PFTs we added:

In the results (P.16, l.21-23 ff.):

“For the forest PFTs, the effect of Q_{10} ($\text{Ens}_{\text{P}+Q_{10}}$) on the uncertainty of the regional scale $\sum \text{GPP}_{\text{PFT}}$, $\sum \text{ER}_{\text{PFT}}$ and $\sum \text{NEE}_{\text{PFT}}$ was much stronger than the effect of both uncertain meteorological forcings and initial states (CLM- Ens_{PAI}).”

In the discussion (P. 17 l.24 ff.):

“The crucial role of the Q_{10} parameter for carbon stock and flux predictions and the respective uncertainties in most land surface models was already highlighted in previous studies (Post et al., 2008; Hararuk et al., 2014, Post et al., 2016). Post et al. (2016) showed that Q_{10} correlates strongly with other CLM4.5 key parameters like f_{NR} and the Ball-Berry slope of stomatal conductance as well as with the initial carbon-nitrogen pools. This may explain why the spread of the regional scale $\sum \text{GPP}_{\text{PFT}}$, $\sum \text{ER}_{\text{PFT}}$ and $\sum \text{NEE}_{\text{PFT}}$ in $\text{Ens}_{\text{P}+Q_{10}}$ was notably higher for coniferous forest than for the other PFTs (Figure 6). “

Changes in the wording of the last part in the conclusions (p.19, l 23ff):

“The effect of uncertainty of atmospheric forcing data on the LAI and NEE uncertainty was considerably higher for C3-grass and C3-crop than for the forest PFTs. This is related to the C3-crop/C3-grass specific phenology representation and model internal thresholds in CLM. Many of these thresholds relate to temperature and strongly control leaf onset and senescence. The strong effect of the perturbed forcing data on modelled carbon fluxes in CLM4.5 is closely linked to the effect of uncertain model parameters like the temperature coefficient Q_{10} .

The model uncertainty resulting from uncertain atmospheric forcing data for C3-grass and C3-crop is additionally enhanced because these crops are located in the northern part of the catchment which is prone to some drought stress in summer. In combination with soil moisture related model thresholds, the effect of the perturbed precipitation on modelled NEE and LAI can be regionally different due to differences in the regional climate. This stresses the importance of regional scale modelling.”